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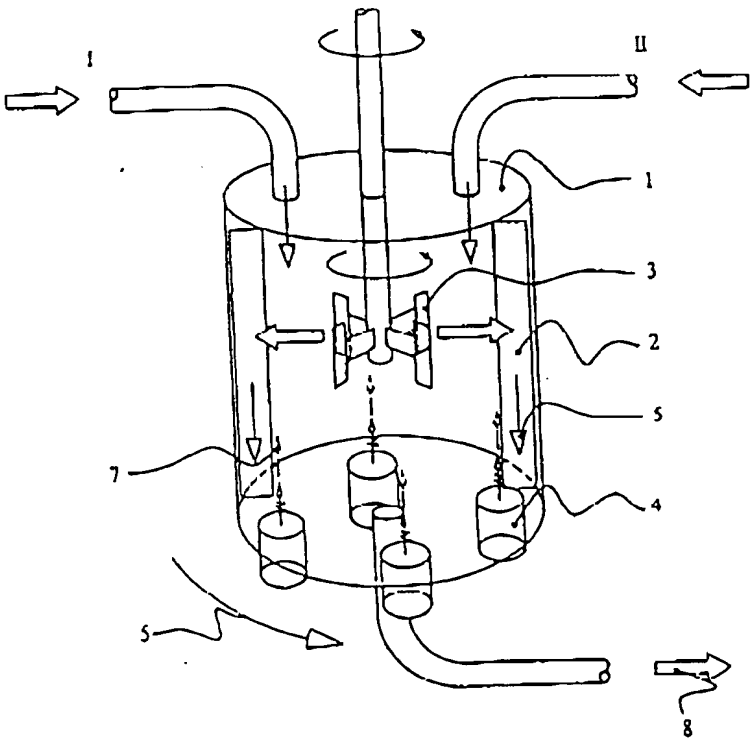
(54) Title: METHOD AND APPARATUS FOR CONTINUOUS HOMOGENISING OF LIQUID IN AN ULTRASOUND CHAMBER



(57) Abstract: Method and an apparatus for continuous homogenising or emulsification of liquid (I, II), where liquid (I, II) in an ultrasound chamber (1) with lamellas (2) or guiding plates (2), especially placed close to the outer wall of the chamber (1), has been subjected to a cinematic mechanical treatment, e.g. by stirring (3), and with a continuous flow of liquid, which has been guided past the surface of a number of ultrasound transducers (4), where the transducers (4) drive in a succession (5), where at least one transducer (4) is resting.

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Method and apparatus for an optimum integrated process of homogenising

The invention relates to a method as an apparatus for continuous homogenising or emulsification of liquid, where the liquid in a ultrasound chamber with lamellas or guiding plates, especially placed on the outer walls of the chamber, but also possibly with a place in the area up to this, can be submitted to a cinematic- mechanical treatment, as an example by stirring , and with an continuous stream, which subsequently is guided over the surface of several ultrasound generators.

Hitherto has it according to the US patent no. 3.614.069 been known to use ultrasound for emulsification or mixing by using varying frequencies and intensity.

The disadvantage has here been that every single ultrasound transducer has been overloaded too much by and with a continuous and simultaneous driving of the whole arrangement of ultrasound transducers, why every single generator has not been able to drive with an optimum yield , and with this, with an optimum effect.

Another disadvantage by the American system according to US. Patent no. 3.614.069 is that it there by the mentioned construction and drifting method is unable to create or induce cavitation by high pressure, which just is known as the working conditions, which our actually invention optimum will be able to work under and by this generally our force of the invention.

Hitherto have there also according to the German patent no. 14.44.377 been known to use apparatus, where lamellas are mounted direct on the outer wall for bettering a mechanical stirring.

The disadvantage by this stationary system has especially been that the plates of the lamellas or the baffles only have been working as break for forced liquid stroking streaming. Where there in front and around these baffles then have been made an indirect mixing and a partial emulsification.

Has there then further, as mentioned in the German patent, been mounted horizontal laying plate rings, then will this arrangement restrain a necessary continuous flow of liquid down to the active surfaces of the ultra sound generators.

The purpose with the invention is to show a method as an apparatus of the in the beginning mentioned sort, as one now by this obtains, to be able to higher and essential better the given effect, for one by this optimum formed emulsion and homogenising of the actually liquids or viscous materials, which continuous have been guided to a mixer chamber. In the same time one obtain also not less to be able to drive the cavitation under very high pressure in the actually ultrasound chamber.

According to the invention, this can be obtained respectively by a driving form for ultra sound transducers, and by the establish dynamic-physical state of the lamellas, and characteristic of, that a majority of transducers are driven in displaced succession, while at least in change one transducer is in rest, as that the lamellas during work can be given a rotating movement.

Conserning to the ultrasound heads the function of invention will be shown under the driving. As one via our invention and the method for a specified transducer head can use higher effect than earlier known by "normally" driving, where one drive continuously. As one according to method and the invention by driving continuous let one ultrasound head of a quantity rest in shift.

There has by this been obtained that the ultrasound head can cool down, before its critical temperature for destruction has been reached. Another advantage is also that the ultrasound head and its electrical resistence is lowering by cooling, why there further also here has been obtained an advantage. Among other things that one now can couple as drive the ultrasound heads more stabile, inside a lesser range of temperature.

A further advantage is also that one, by continuous shift between the heads, further can obtain a higher degree of efficiency of the arrangement. As a shift and stop will change the condition of cavitation, so that the cavitation or emulsification can be more effective or maintain optimum driving in the liquid.

In a specially embodiment of the arrangement, according to the invention, then can one further increase the cavitation as emulsification of the liquid by driving the system under conditions of working, with or under extreme high pressure of working, as an example 16 bar, and with time of stay of the premix in the field of ultrasound on ideal about 20-25 seconds. -Where one so in the same time here in or on every single transducer further use pulsing signals of ultrasound, with essential higher maximum impulses, which are higher here than the actually transducer would allow by a continuous driven. There has here been obtained that the system can be driven under very adverse conditions of cavitation, which the high pressure, as the generally short time of working, has been given. And in the same time with condition ,- with pulsing ultrasound signals, with higher maximum impulse obtain to be able to get an extreme large effect of cavitation, and with this an optimum emulsification as homogenisation of the liquid in the chamber of the mixing.

In another specially embodiment of the arrangement according to the invention, then work the system in the mixing chamber with homogenisation as emulsification, with a working pressure on about 16 bar, and with pulsing ultrasound signals, with higher maximum pulses, than every single transducer by continuous driven can hold. And with further a running resting/ driving function, mentioned "rif" of the transducers, and with also one in the same time pulsing driving or working between 15-120 kHz, or on an ideal working situation on between 20-50 kHz, for a flow of liquid on ideal 1000 litres pr. hour.

There have here been obtained that the driving or working in or with the mentioned limits of frequencies, and within the mentioned way to drive,

optimise and make it possible for a continuous homogenising as emulsification of generally specific flows of liquids or quantities of liquid mass in an actually size of mixing chamber.

In another specially embodiment of the arrangement according to the invention. then can one let the lamellas rotate.
One obtain by this further a cavitation effect, which come from the stroke of the liquid against the rotating single lamella or lamella ring or from similar arrangement. As the speed of the liquid further by the stroke has been accelerated / decelerated dependent of the direction of the rotating as the point of the stroke.

In another embodiment of the arrangement according to the invention, then can further one in the same time rotation be obtained of both the rings of the lamellas, which hold the single lamellas. And the lamellas can also be brought to rotate around its own axle.
One obtain further by this an effect of homogenisation. Which specially could be intensified by the choice of direction of rotating, and the speed of the rotating of the lamellas and the ring itself. And this could even be opposite of each other, or with different speed of rotating.

In another embodiment of the arrangement according to the invention, then can further the effect of emulsification be further increased of, - via that shape of the rotating lamellas have been twisted as a spiral in the length direction of the lamella itself.
One have by this then obtained that the returning stroke of the liquid from the rotating lamella, and seen from the direction of length, then do not get the same picture in the cut or section of length. And in the same time, the liquid will not only be thrown horizontal out, but it will be thrown in slanting direction according to the pitch of the shape of the spiral of the single lamellas itself. And because of the lamella rotate, then will the next quantity

of liquid take another direction. Why an optimum emulsification by this treatment has been obtained.

The invention shall after this be explained in the following under reference to the drawing, where

Fig.1 shows in perspective a ultrasound chamber for homogenisation as emulsification of liquid, with guiding plates and driving or working of the ultrasound transducers in displaced order ,-

Fig.2 shows a ring of lamella- or guiding plates, which rotate together or jointly around or in the centre axle of the ultrasound chamber,-

Fig.3 shows in perspective and seen from the side a single vertical lamella-or guiding plate, which rotate around itself,-

Fig.3B shows a single rotating lamella-or guiding plate as Fig.3, but seen from upper, and

Fig.4 shows a picture of pulsing guiding ultrasound signals.

Fig.1 Shows in perspective a ultrasound chamber **1** for homogenisation as emulsification of liquid(s) **I as II**, with guiding plates **2** and working or driven of ultrasound transducers **4** which self each and together work in displaced order.
The figure shows an example of an embodiment with vertical placed chamber **1** or boiler **1**, which self also in the same time make a pressure safe chamber of mixing **1**.

From above in the mixing chamber **1** according to the figure (Fig.1) can there ideally as an example be lead liquid respectively **I as II**, as one want mixed and homogenised for a total leaving mix **8** , as an example an emulsion **8.** The liquids **I as II,** which in the example of embodiment have been supplied from above in the chamber of mixing **1,** will immediately after this be influenced of an arrangement of wheel of scoop **3.** Where the just now partly mixed liquid **I as II** via the wheels of scoops **3** will be thrown against the guiding plates **2,** and in the same time, because of the liquids **I as II** continuous have been supplied from above via supply lines,- then will the partly homogenised liquid be led against the bottom of the chamber **1** to the exhauster pipe **8,** and to continued treatment via the ultrasound transducers **4.**

The ultrasound arrangement **4** can as shown on the figure ideal as an example consist of four ultrasound transducers **4.** Which as an example could work in the field from 18-120 kHz, but still as here ideal as an example in the field from 20 -50 kHz.

An ideal cycle of mutual working operation for the transducers **4** will be by a continuous mutual changing **5** as "rif" **5** between these. So that some of the transducers **4** drive, and other transducers **4** do not drive.
As an example with that one drive or work with three transducers **4** at a time, and so successive working or driving of the common system of the transducers **4**. As an example by turning or shift one transducer **4** ahead in the common transducer system, and as an example and alternative by turning or shift **5** against the watch. And as an example ideal by driving three transducers **4** at a time. Where for that matter the one transducer **4** continuous in its "rif" **5** or changing will be new.

The advantages by this driving form **5** will be that one will lower the effect of the "cross-talk" . Which will say that the transducers **4** works as receiver of mechanical energy there have been transformed to electrical energy. And in

such a way end as heat in the electrical generators there drive the transducers **4.**

With the shown special shift or operation **5** and according to the invention, so give this driving form **5** a possibility to regular cooling of the transducers **4.** And this will make a better stability of the impedance as the resonance effect of the whole system. And moreover this driving form **5** or working form **5** will extend the living time of total the equipment **4.**

By further driving the transducers **4** with a pulsing cavitation **7,** then you obtain in addition an optimal and total homogenising of the to the mix-chamber **1** supplied liquids **I as II** and even fluid mass too. As one then, qua this method **7,** by a pulsing cavitation combined with a "rif"- driving of the transducers itself, and under high working pressure as an example 16 bar obtain to make an extreme dense or homogenous field of cavitation. And then where this field can be maintained of the following "week" signals **10.**

Fig.2 shows a ring of lamellas -or guiding plates **2,** which rotate **9** together or joint around/in the centre axle of the ultrasound chamber**1.**

The system **2** could consist of as an alternative several rotating **9** ring systems or rims **9'** with vertical sitting plates of lamellas-or guiding plates **2.** Where these **2** or the rims **9'** then perhaps alternative ideal could drive or work opposite each other **2,** as **9',** or perhaps with different speed or both working operations in combination.

When the plates of lamellas or guiding plates **2** rotate **9,** then will this cause an extra mixing of the supplied liquids **I as II.** And especially if the supplied liquids **I as II** in advantage already have been blended by an arrangement of paddle wheels **3** in the middle of mix-chamber **1.**

Fig.3 shows in perspective and seen from the side a single vertical lamella-or guiding plate **2,** which rotate around itself.

The arrangement **2** could of cause also be combined with the system, which is shown in Fig.2.

The system will especially has an extra effect, if the system turn opposite of, what the arrangement of middle rings system **3** do.

Fig 4 shows a picture of a pulsing **7** ultrasound signal **10**, which drive or work as a whole. And which drive as a part of the "rif"- driving of the ultrasound transducers **4**, namely in a displace succession **5**, with one transducer **4** in rest, by which there, by this summing up driving, has been obtained a specially effect namely a "synergi"-effect, in the effectiveness of the total effect of homogenising. And which effect therefore is larger than one logical could think, with or by every one of the single section-operations or working forms **5 as 7**, "looked" driven for itself and without the other working form as supplement .

Claims

1. Method for continuous homogenising or emulsifying of liquids **(I as II)**, where the liquid **(I as II)** in a ultrasound chamber **(1)** with lamellas **(2)** or guiding plates **(2)**, especially placed in the outer edge or wall of the chamber **(1)** , -but also fields up to this,- have been submitted a cinematic treatment as an example by stirring or mixing**(3)**,- and where the liquids **(I and II)** in a continuous stream has been guided past the surface on more generators of ultrasound transducers **(4)**, **charateristic of,** that a majority of ultrasound transducers **(4)** drive or work in a displaced succession **(5)**, with a least one transducer **(4)** in change, and which in the same time is in rest.

2. Ultrasound apparatus for continuous homogenising according claim 1, **charateristic of,** to be able to increase the cavitation as the emulsifying of the liquid **(I as II)**, by driving the system under conditions of working with or under extreme pressure of working ideal as an example 16 bar, and with delaying times on ideal about 20-25 seconds, and where one or you in the same time on each single transducer **(4)** use pulsing ultrasound signals **(7)** with essential higher maximum impulses **(10)** , which are higher **(10)** than the actually transducer **(4)** would allow under a continuous drift .

3. Ultrasound apparatus for continuous homogenising according to claim 1 as 2, **charateristic of,** that one drive the pulsing ultrasound signals **(7)** as resting/driving functional -"rif" **(5)**, and with one in the same time frequency **(10')** on between 15-120 kHz. or ideal normally on between 20-50 kHz.

4. Ultrasound apparatus for continuous homogenising according claim 1 , **charateristic of,** that the lamellas **(2)** in the mixing chamber **(1)** under drift can be given a rotation movement or stirring **(9)**.

5. Ultrasound apparatus for continuous homogenising according to claim 1, **c h a r a t e r i s t i c of,** to have one as several rings of lamellas **(9')** in the mixing chamber **(1)** , which can rotated **(9)** around itself or themselve, alternative to have one as more rings of lamellas **(9')**, where every single lamella **(2)** can rotate around itself, and as alternative an embodiment, where one can combine both rotation systems together.

6. Ultrasound apparatus for continuous homogenising according to claim 1, **c h a r a t e r i s t i c of,** that every lamella **(2)** or single of them, in the mixing chamber **(1),** in itself can be made twisted or made in a shape of spiral or in a like embodiment or shape.

Abstract

Method as an apparatus for continuous homogenising or emulsification of liquid **(I as II)**, where the liquid **(I as II)** in a ultrasound chamber **(1)** with lamellas **(2)** or guiding plates **(2)**, especially placed in the outer edge or wall of the chamber **(1)**, but also with even a placing in the field up to this, has been subjected a cinematic mechanical treatment as an example by stirring **(3)**, and with a continuous flow of liquid, which has been guided past the surface of more ultrasound transducers **(4)**, where the transducers **(4)** are drive in a displaced succession **(5)** , with a least one transducer **(4)** in shift, which is in rest.

Fig.4

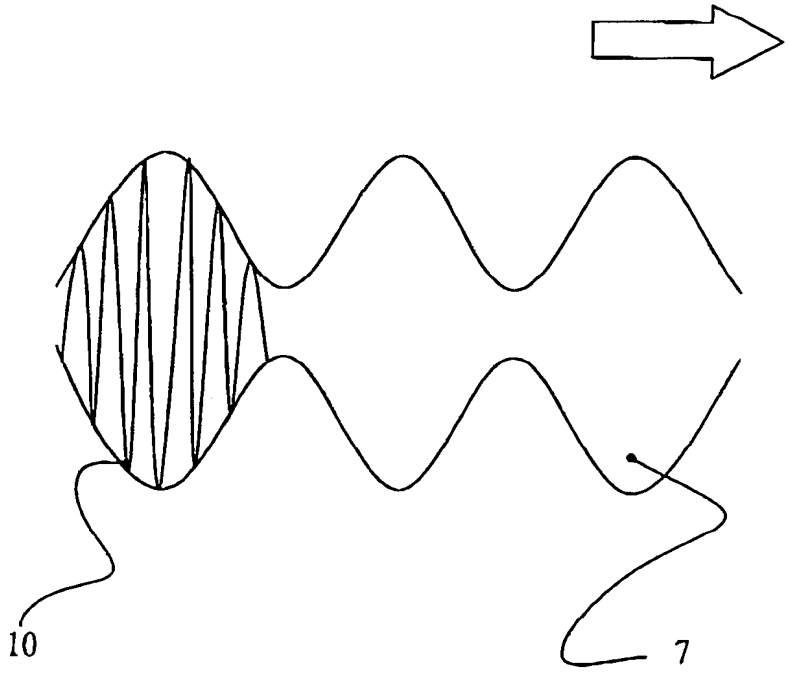


Fig.2

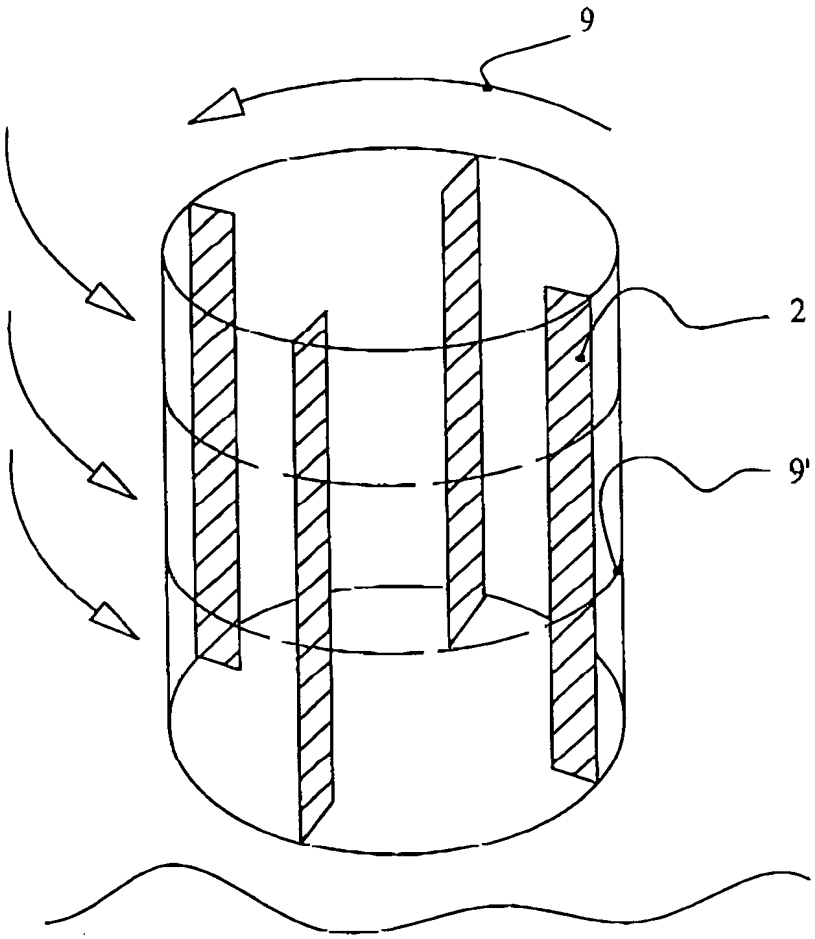


Fig.3

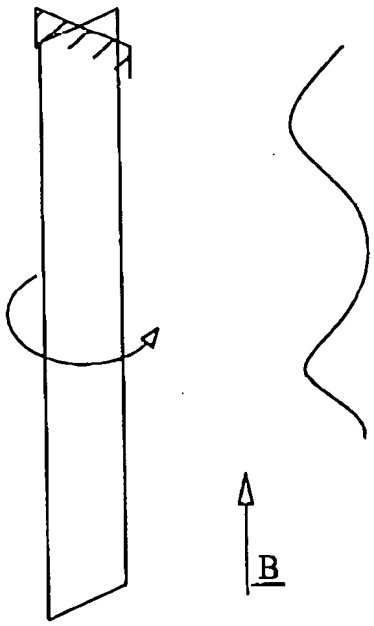


Fig.3B

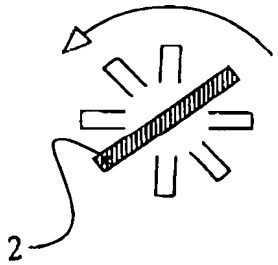
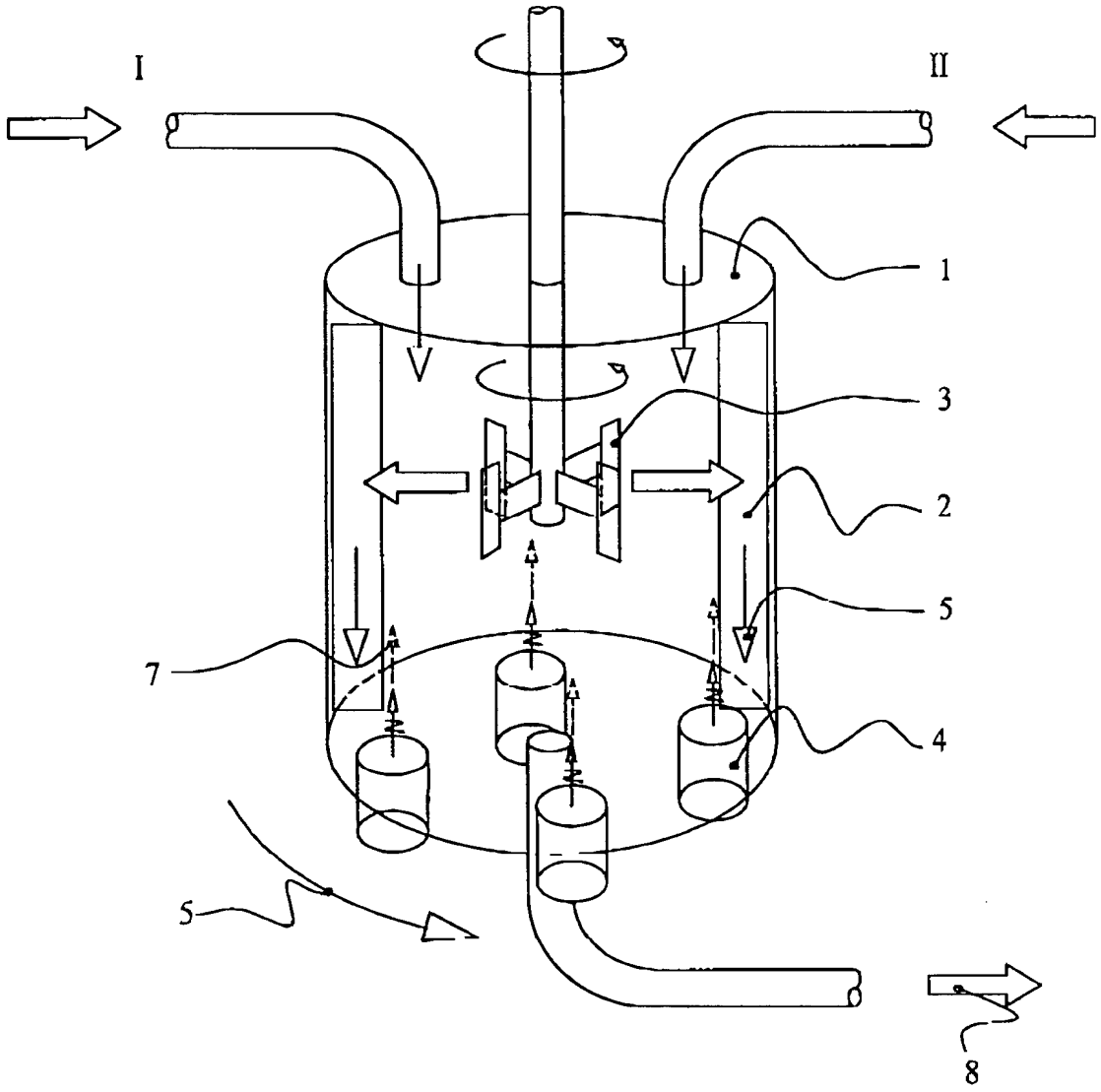


Fig.1



INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 00/00088

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B01F 11/02
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SE 412702 B (RESON SYSTEM APS), 17 March 1980 (17.03.80), figures 1,2, claim 1 --	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
27 July 2000	30 -08- 2000
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INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
SE 412702 B	17/03/80	NONE	